REMARKS

The Office Action mailed January 30, 2003, has been received and reviewed. Claims 1 through 42 are currently pending in the application. Claims 1 through 42 stand rejected. Applicants have amended claims 18, 24, 26, 27, and 33 and respectfully request reconsideration of the application as amended herein.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on U.S. Patent No. 4,756,871 to Mallener in view of U.S. Patent No. 6,125,912 to Branagan et al.

Claims 1 through 4, 7, 21 through 23, 32, 41 and 42 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,756,871 to Mallener ("Mallener") in view of U.S. Patent No. 6,125,912 to Branagan et al. ("Branagan"). Applicants respectfully traverse this rejection, as hereinafter set forth.

> M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:
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> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

The 35 U.S.C. § 103(a) obviousness rejections of claims 1 through 4, 7, 21 through 23, 32, 41 and 42 are improper because there is no motivation to combine the references, there is not a reasonable expectation of success of the combination, and the combination of references fails to teach or suggest all the claim limitations.

Mallener teaches that a neutron-absorbing substance may be applied to nuclear fuel elements by immersion, spraying, and/or pouring to minimize the possibility of critical mass attainment. More particularly, Mallener teaches that the method and coatings may be particularly suited to graphite or carbon containing nuclear fuel elements. (Col. 1, lines 18-28). Further,

Mallener teaches that when graphitic nuclear fuel elements are immersed in gadolinium acetate solution the solution does not merely adhere to the surfaces, but penetrates the graphitic material improving both the safety during storage and also during transport of the fuel elements. (Col. 3, lines 13-47).

Branagan teaches that a neutron absorbing material may be fabricated by incorporation of rare earth elements into a passive matrix phase which will provide high resistance to electrochemical attack. Branagan teaches that the neutron absorbing metallic glasses may be fabricated by rapid cooling of molten passive matrix phase, rare earth elements, and glass forming elements. (Col. 3, lines 11-26).

There is no motivation to combine the teachings of Mallener and Branagan because, from the disclosure of each patent, each neutron absorbing material was purportedly independently successful. The invention of Mallener, as is, is purported to exhibit adequate properties both in neutron absorbing characteristics as well as physical properties.

Furthermore, there is no suggestion or motivation to combine the teachings of Branagan with Mallener, since Mallener does not acknowledge any need for corrosion protection. It appears that the invention of Mallener is not concerned with corrosion issues since only the addition of a water repellent film was included in the invention. Furthermore, since the invention of Mallener primarily concerns neutron absorbing material deposited on or in *graphitic* fuel elements, one of ordinary skill in the art would not be motivated to combine the corrosion resistant material of Branagan with the invention of Mallener *because graphite typically does not corrode*. In the case of metal sheathed fuel elements, use of the coating of Branagan would be redundant to the gadolinium coating method taught by Mallener.

Even assuming, *arguendo*, that the invention of Mallener would be employed with a substrate material that is subject to corrosion, at least two embodiments as taught by Mallener teach away from the proposed combination with Branagan. First, Mallener discloses (Example 4) that gadolinium oxide is water insoluble and is immobile in the graphitic material even at high temperatures, becoming an integrated component of the spent fuel element. (Col. 5, lines 30-38). Second, Mallener provides that gadolinium acetate in solution may be applied to the spent fuel elements or a plastic foil or film containing gadolinium acetyl acetonate can be applied in

emulsion or melt form. (Col. 3, lines 13-24). The gadolinium acetate is disclosed to penetrate the graphite of the fuel elements, or the plastic foil or film coats the fuel elements. Therefore, one of ordinary skill in the art would not be motivated to combine the corrosion resistant material of Branagan with the invention of Mallener because to do so would render at least some embodiments of the Mallener invention superfluous. In other words, Mallener coats or penetrates the graphite fuel elements with a gadolinium material, while Branagan includes a neutron absorbing material (gadolinium) in a passive, corrosion-resistance matrix phase to form a corrosion-resistant, neutron-absorbing material. Thus, there would be no motivation to coat the gadolinium coated fuel elements of Mallener with yet another material exhibiting neutron absorbing characteristics.

It should also be noted that Branagan teaches and suggests that iron based systems are especially useful for spray coating by processes such as high-energy plasma (HPS), low pressure plasma spraying (LPPS), high-velocity oxyfuel (HVOF), and other spray forming processes **on existing steel surfaces** such as storage containers and steel drums. (Col. 3, lines 5-10). (Emphasis added). Therefore, Branagan does not teach or suggest the use of metallic glasses on existing neutron absorbing materials. Further, with respect to metal sheathed fuel elements, the Branagan coating would be redundant to the neutron-absorbing coating applied as taught by Mallener.

There is not a reasonable expectation of success in including the corrosion resistant coating of Branagan with the graphitic fuel elements of Mallener because the materials suggested by Branagan appear to be incompatible with the graphitic fuel elements as taught by Mallener. First, if iron is used as taught by Branagan, iron has an affinity for carbon at relatively low temperatures. Using the thermal spraying techniques as taught by Branagan to deposit iron containing materials may thus cause the graphitic fuel elements to chemically react with the iron contained within the coating. Further, such a reaction may change the carefully tailored properties of the neutron absorbing metallic glasses. In the case of nickel and copper, neither metal wets (adheres) to the surface of graphite and therefore may not be suitable for use as a corrosion-resistant coating for the neutron absorbing material of Mallener. Nickel and copper material systems are used in the fabrication of tungsten carbide drill bits where copper-tin-nickel

material is melted into a graphite mold for easy release therefrom after solidification. Thus, it is apparent that the nickel/copper base metal systems of Branagan would not adhere to the surface of a graphitic fuel element. In addition, affixing an alloy to a graphitic fuel element may not be successful because the differences in thermal expansion rates due to differences in the respective coefficient of thermal expansion (CTE) of the two materials (graphite and a metallic glass coating) tend to cause delamination of the materials from one another. Therefore, there is not a reasonable expectation of success in the combination of the thermal spraying techniques to apply materials as taught by Branagan with the graphitic fuel elements as taught by Mallener.

Moreover, the use of a thermal spraying method as taught by Branagan to deposit metallic glasses upon a coating of gadolinium acetate may have deleterious effects. Mallener teaches that the coating of gadolinium acetate decomposes above about 750° C. (Col. 5, lines 27-32). Although Mallener teaches that the creation of gadolinium oxide may be advantageous, chemical reactions may occur between the thermally sprayed metallic glasses of Branagan and the coating as taught by Mallener that may reduce the effectiveness of the neutron absorbing material or may create materials that do not resist corrosion. Alternatively, the creation of gadolinium oxide may frustrate the adhesion of the thermally sprayed coating of Branagan. Neither the Branagan reference nor the Mallener reference teaches or suggests that spray deposition of metallic glasses as taught by Branagan upon the neutron absorbing coating of Mallener would be successful.

Also, combining the coating of Mallener with the thermally sprayed metallic glass as taught by Branagan would likely frustrate the desired *removal* of the coating as taught by Mallener. As shown in FIG. 1 of Mallener, fresh fuel may be coated and then the coating removed at 25, prior to use. In addition, spent nuclear fuel may be coated and then the coating removed at 21 prior to reprocessing. Therefore, one of skill in the art would not be motivated to apply the thermally sprayed coating of Branagan to the coating of Mallener because to do so may frustrate the removal of the coating as contemplated by Mallener for use of a coated fuel element or reprocessing of a coated, spent fuel element.

Applicants respectfully request reconsideration and allowance of independent Claim 1.

Claims 2 through 4 each depend, either directly or indirectly from independent Claim 1, which is allowable. Applicants respectfully request reconsideration and allowance of Claims 2

through 4.

Claim 7 recites the presence of a top coat layer comprising a nickel-based alloy substantially free of a neutron absorbing material. Applicants respectfully contest the Examiner's interpretation of Branagan, and respectfully asserts that Branagan does *not* teach a nickel-based alloy substantially free of a neutron absorbing material. While Table 1 of Branagan teaches that gadolinium in an **atomic** concentration of as little as 1% may be present for purposes of proving that an appropriate alloy may be formed, Branagan further **claims** methods of making **neutron absorbing materials** wherein the total amount of gadolinium is **0.1** to 50 atomic percent of the base alloy composition, thus necessarily implying that even a 0.1 atomic percent constituency of gadolinium provides a neutron absorbing function. Applicants respectfully request reconsideration and allowance of Claim 7.

The Office Action rejects Claims 21 and 22 as being anticipated by Mallener in combination with Branagan. However, Claims 21 and 22 each depends directly from Claim 20, which is apparently, from the context of the Office Action, not rejected by Mallener solely in combination with Branagan but requires the additional reference of Papai. Claims in dependent form shall be construed to include all the limitations of the claim incorporated by reference into the dependent claim. MPEP § 608.01(i). Applicants respectfully request clarification as to the rejection of Claims 21 and 22. In any case, Claims 21 and 22 are allowable as depending from Claim 20 for the reasons set forth below. Applicants respectfully request reconsideration and allowance of Claims 21 and 22.

Independent Claim 23 recites a neutron absorbing composition including a metal alloy material and a plurality of neutron absorbing particles comprising gadolinium oxide dispersed in the metal alloy material. Neither Branagan nor Mallener, taken alone or in combination teach or suggest all the claim limitations. Branagan teaches that intermetallic materials may be formed with elemental gadolinium. (See Table 1). Mallener teaches the formation of gadolinium oxide by way of decomposition of absorbed gadolinium acetate within a graphitic fuel element and thus does not teach all the claim limitations. (See Example 4). The combination of references clearly does not teach or suggest the claimed metal alloy material comprising nickel, molybdenum, chromium, tungsten and iron having neutron absorbing particles dispersed therein comprising

gadolinium oxide. Applicants respectfully request reconsideration and allowance of Claim 23.

The Office Action rejects Claim 32 as being obvious by Mallener solely in combination with Branagan. However, Claim 32 depends from Claim 26, which is not rejected using Mallener solely in combination with Branagan. Claims in dependent form shall be construed to include all the limitations of the claim incorporated by reference into the dependent claim. MPEP § 608.01(i). Applicants respectfully request clarification as to the rejection of Claim 32.

In any case, Claim 32 claim recites the presence of a top coat layer comprising a nickel-based alloy substantially free of a neutron absorbing material. As stated above with respect to claim 7, Applicants respectfully submit that Branagan does not teach a nickel-based alloy substantially free of a neutron absorbing material. Applicants respectfully request reconsideration and allowance of Claim 32.

The Office Action rejects Claim 41 as being obvious by Mallener in combination with Branagan. However, Claim 41 depends indirectly from Claim 35, which is not rejected using Mallener solely in combination with Branagan. Claims in dependent form shall be construed to include all the limitations of the claim incorporated by reference into the dependent claim. MPEP § 608.01(i). Applicants respectfully request clarification as to the rejection of Claim 41. In any case, Claim 41 is allowable as depending from Claim 35.
Applicants respectfully request reconsideration and allowance of Claim 41.

The Office Action rejects Claim 42 as being obvious by Mallener in combination with Branagan. However, Claim 42 depends from Claim 35, which is not rejected using Mallener solely in combination with Branagan. Claims in dependent form shall be construed to include all the limitations of the claim incorporated by reference into the dependent claim. MPEP § 608.01(i). Applicants respectfully request clarification as to the rejection of Claim 42.

Further, Claim 42 includes forming a top coat layer comprising a nickel-based alloy substantially free of a neutron absorbing material, which Applicants respectfully submit Branagan does not teach as previously noted with respect to claim 7. Applicants respectfully request reconsideration and allowance of Claim 42.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on U.S. Patent No. 4,756,871 to Mallener in view of U.S. Patent No. 6,125,912 to Branagan et al., in further view of U.S. Patent No. 4,780,268 to Papai et al., and in still further view of U.S. Patent No. 5,980,604 to Lavernia

Claims 5, 6, 8 through 20, 24 through 31, and 33 through 40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,756,871 to Mallener in view of U.S. Patent No. 6,125,912 to Branagan et al. in further view of U.S. Patent No. 4,780,268 to Papai et al. ("Papai") and (apparently) in still further view of U.S. Patent No. 5,980,604 to Lavernia ("Lavernia"). Applicants respectfully traverse this rejection, as hereinafter set forth.

The teachings of Mallener and Branagan are discussed hereinabove.

Papai teaches a neutron absorber element comprising a refractory coating containing gadolinium oxide bonded to a metallic substrate.

Lavernia teaches spray atomization of molten metal and/or intermetallic matrix composites reinforced with ceramic particles under a reactive or controlled atmosphere. The resulting materials exhibit unusual combinations of properties, such as spatially varying properties.

There is no motivation to combine the teachings of Papai with the teachings of Branagan because Papai expressly teaches away from thermal spraying as employed by Branagan. Papai teaches that thermal spraying utilizing boron carbide in combination with stainless steel powders yielded was not successful. (Col. 3, lines 3-7). The Examiner is respectfully reminded that it "is improper to combine references where the references teach away from their combination." M.P.E.P. §2145(X)(D)(2) (citing In re Grasselli, 713 F.2d 731, 743, 218 U.S.P.Q. 769, 779 (Fed. Cir. 1983)). Applicants respectfully submit that the combination of thermal spraying as taught by Branagan would render the invention of Papai unsuitable for its intended purpose because Papai specifically teaches such an approach is unsuccessful. If a "proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." M.P.E.P. §2143.01 (citing In re Gordon, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984)).

Furthermore, there is no motivation to combine the nickel coating as taught by Papai with

the invention of Mallener because Papai teaches that a nickel flash may be applied to a **steel substrate** prior to application of the refractory coating. Mallener, as discussed above, teaches the application of a neutron absorbing material that is partially absorbed by a graphitic fuel element. Applicants respectfully submit that one of skill in the art would not be motivated to combine the nickel flash as taught by Papai for steel materials with the graphitic fuel elements as taught by Mallener. In the case of a metal sheathed fuel element as taught by Mallener, the gadolinium is applied galvanically from solution, such process not requiring a nickel flash as employed by Papai for application of a refractory coating.

Even assuming, *arguendo*, that the nickel flash of Papai were combined with the invention of Mallener, such a combination would change the principle of operation of Mallener. Specifically, the bond coat layer is formed between the substrate and the neutron absorbing layer. However, if the nickel layer of Papai were formed on the graphitic fuel elements as taught by Mallener, the purported advantages of the neutron absorbing material penetrating the graphitic material as taught by Mallener would be eliminated because the nickel layer would prevent such penetration. In the metal sheathed fuel element embodiment of Mallener, a nickel layer would be superfluous due to the galvanic process used to apply the gadolinium from solution.

In further contrast, the gadolinium intermetallic materials as taught by Branagan are incompatible with the neutron absorbing materials of Papai or Mallener because simple mixing of gadolinium compounds as taught by Papai or Mallener changes the principle of operation employed to form chemically alloyed intermetallic materials as taught by Branagan.

"If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious." M.P.E.P. §2143.01 (citing In re Ratti , 270 F.2d 810, 123 USPQ 349 (CCPA 1959).

As to Lavernia, there is no motivation to utilize the complicated deposition apparatus and methods as taught by Lavernia with Mallener, Branagan, or Papai. As to Mallener, immersion or spraying is taught to facilitate penetration of the neutron absorbing material into the graphitic fuel elements. Branagan teaches a thermal spraying technique for applying neutron absorbing materials to steel containers. Papai teaches that thermal spraying was unsuccessful and therefore

teaches application and bonding of cermet coatings using standard enameling or cermet techniques. Furthermore, there is no reasonable expectation of success in combination of such disparate application systems, especially with the advantages and limitations as taught by each reference.

One of skill in the art would not be motivated to combine the teachings of Lavernia with any of the other references because none of the other references teach or suggest a need to provide gradational characteristics within the neutron absorbing coatings, conduct depositions under spray atomization, to control pore sizes and distribution within the neutron absorbing coating, or to conduct reactive spray atomization.

Applicants respectfully submit that "it is impermissible to use the claimed invention as an instruction manual or 'template' to piece together the teaching of the prior art so that the claimed invention is rendered obvious . . . . One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." *In re Fritch*, 23 U.S.P.Q.2d 1780 (Fed. Cir. 1992).

Claims 5, 6, 8, 9, 10, and 12 each depend, either directly or indirectly, from Claim 1, which is allowable. Applicants respectfully request reconsideration and allowance of Claims 5, 6, 8, 9, 10, and 12.

Further, it appears that the Examiner is alluding to the use of the nickel flash of Papai as equivalent to the bond coat layer recited in Claim 10. Use of the Papai nickel flash layer on a graphite fuel element is inappropriate. If a metal sheathed fuel element is to be galvanically coated, as taught at Col. 4, lines 44-61 of Mallener, there is no apparent need for such a layer. If a layer of material is applied according to Branagan, again there is no apparent need for a bond coat layer.

Claim 11 recites bond coat layers that are selected from the group consisting of stainless steel and boron compounds. Applicants respectfully submit that the references, taken alone or in combination fail to teach or suggest all the claim limitations. Further, Claim 11 depends indirectly from independent Claim 1, which is allowable. Applicants respectfully request reconsideration and allowance of Claim 11.

Applicants respectfully request reconsideration and allowance of independent Claim 13,

as the references cited, in combination, fail to teach or suggest the recited graded coating layer exhibiting a gradual decrease in the amount of neutron absorbing particles toward an outer surface of the graded coating layer. Lavernia teaches that a layered functionally graded pore structure can be generated, but there is no teaching or suggestion, other than Applicants' own disclosure, as to why one would be motivated to combine Lavernia with the other references to obtain the claimed gradient of neutron-absorbing material.

Claims 14 and 15 each depend directly from independent Claim 13, which is allowable. Applicants respectfully request reconsideration and allowance of Claims 14 and 15. In addition, as noted above, there is no apparent motivation for use of a bond coat layer in the structure of Mallener.

Applicants respectfully request reconsideration and allowance of independent Claim 16, as any combination of the references applied does not appear to teach or suggest the claimed combination of a metal alloy matrix and a plurality of neutron absorbing particles comprising a material selected from the group consisting of gadolinium oxide, gadolinium phosphate, and mixtures thereof. Mallener does not teach gadolinium in a metal matrix. Branagan does not teach the use of gadolinium oxide or phosphate. Papai employs gadolinium oxide in a refractory, ceramic coating.

Claim 17 depends directly from independent Claim 16, which is allowable. Further, and again, there appears to be no motivation to employ a bond coat layer in the combination of references as applied. Applicants respectfully request reconsideration and allowance of Claim 17.

Claim 18, as presently amended, recites the presence of a neutron absorbing layer comprising a ceramic material matrix having a plurality of neutron absorbing particles dispersed therein, the neutron absorbing particles including gadolinium phosphate. Applicants respectfully submit that the references, taken alone or in combination fail to teach all the claim limitations. Applicants respectfully request reconsideration and allowance of independent Claim 18, as presently amended.

Claim 19 depends directly from Claim 18, which is allowable. Applicants respectfully request reconsideration and allowance of Claim 19.

Claim 20 recites a metal alloy material having a plurality of neutron absorbing particles dispersed therein, the neutron absorbing particles comprising a material selected from the group consisting of gadolinium oxide, gadolinium phosphate, and mixtures thereof. Applicants respectfully submit that the references taken alone or in combination fail to teach all the claim limitations, as nowhere appears a teaching of the claimed neutron absorbing materials in combination with a metal alloy material, or a suggestion as to the desirability of so doing. Applicants respectfully request reconsideration and allowance of independent Claim 20.

Claim 24, as presently amended, includes a ceramic material having a plurality of neutron absorbing particles dispersed therein, the neutron absorbing particles including gadolinium phosphate. Applicants respectfully submit that the references taken alone or in combination fail to teach or suggest all the claim limitations. Applicants respectfully request reconsideration and allowance of independent Claim 24, as presently amended.

Claim 25 depends directly from independent Claim 24, which is allowable. Applicants respectfully request reconsideration and allowance of Claim 25.

Applicants respectfully request reconsideration and allowance of independent Claim 26, which is allowable for the same reasons as set forth above with respect to claim 1. Papai does not cure the deficiencies of the other references.

Claims 27 through 31 each depend, either directly or indirectly, from independent Claim 26, which is allowable. Applicant respectfully requests reconsideration and allowance of Claims 27 through 31.

Claim 33 depends directly from independent Claim 26, which is allowable. Further and again, there is no apparent motivation in the references as applied for the use of a bond coat layer as claimed. Applicants respectfully request reconsideration and allowance of Claim 33.

Claim 34 includes a bond coat layer comprising a material selected from nickel-based alloys, stainless steel, boron compounds and combinations thereof. Applicants respectfully submit that the references, taken alone or in combination, fail to provide any motivation for the use of a bond coat layer as claimed. Claim 34 depends indirectly from independent Claim 26, which is allowable. Applicants respectfully request reconsideration and allowance of Claim 34.

Independent Claim 35 recites forming a neutron absorbing layer and forming a corrosion

resistant top coat layer. Applicant respectfully requests reconsideration and allowance of independent Claim 35 for the same reasons set forth above with respect to claim 1.

Claims 36 through 40 each depend, either directly or indirectly from independent Claim 35, which is allowable. Applicant respectfully requests reconsideration and allowance of Claims 36 through 40.

Applicants respectfully submit that the Examiner has assembled a combination of references teaching, in isolation, features and elements of Applicants' invention as set forth in the various claims. However, absent Applicants' own disclosure, there is nowhere provided any motivation to combine the isolated features and elements to arrive at Applicants' claimed invention. Such use of Applicants' disclosure is, of course, impermissible and, therefore, the rejections of claims 1 through 42 should be withdrawn.

ENTRY OF AMENDMENTS

The amendments to claims 18, 24, 26, 27, and 33 above should be entered by the Examiner because the amendments are supported by the as-filed specification and drawings.

CONCLUSION

Claims 1 through 42 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, he is respectfully invited to contact Applicants' undersigned attorney.

Respectfully submitted,

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